(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 727 299 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
27.10.1999 Bulletin 1999/43

(21) Application number: 96101547.6

(22) Date of filing: 03.02.1996

(51) Int. Cl.$^6$: B29C 47/06, B29C 51/14, B32B 27/32
// B29K23:00, B29K105:06

# (54) Method of producing composite materials, stratiform composites and containers made therefrom

Verfahren zur Herstellung von Verbundwerkstoffen, Mehrschichtverbundplatten und Behälter daraus

Procédé de fabrication de matériaux composites multicouches, panneaux composites multicouches et conteneurs fabriqués à partir de tels panneaux

(84) Designated Contracting States:
DE ES FR GB IT NL SE

(30) Priority: 14.02.1995 IT MI950262

(43) Date of publication of application:
21.08.1996 Bulletin 1996/34

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Printed by Xerox (UK) Business Services
2.16.7/3.6

## Description

[0001] European patent application EP-A-0 668 142 (published after the priority date of the present application and thus considered as state of the art according to Article 54(3) EPC) concerns a procedure for manufacturing laminated thermoformable panels for use as vehicle doors, trays or packaging containers by simultaneous extrusion of (I) a matrix (also termed central layer) made of what is termed a homogenized and gelled pre-mix of organic fibers plus a polyolefin formed in a counter-rotating double-screw extrusion press, and (II) two external layers made of polyolefin and a mineral filler formed by means of a co-rotating double-screw extrusion press.

[0002] Such double-screw or "twin screw" extruders of both the counter-rotating as well as the co-rotating type are known in the art and European patent 0 426 619 illustrates a particular preferred extruder of the latter type.

[0003] According to European patent application EP-A-0 668 142 mentioned above, organic fibers are used as filler for the central layer, apparently intended to serve as a carrier or bulk layer for the laminate; a 50/50 mixture of an olefin with organic fibers is mentioned in the example of EP-A-0 668 142 for the central matrix layer while a 60/40 mixture of an olefine and a mineral filler is used to extrude the external layers which are said to provide a better finish of panels made of these materials if compared with prior art panel materials. Further, it is alleged in EP-A-0 668 142 that the panel structures described therein have a different structure and are made of components that provide for better quality and characteristics than prior art panels.

[0004] The present invention, according to a first aspect thereof, aims at a method of producing a composite stratiform material by co-extrusion of at least three layers, each comprising polypropylene and at least one filler, said co-extrusion being effected by means of at least two, and preferably three, extruders each having a pair of co-rotating screws, characterized by co-extrusion of: (I) a carrier layer formed of a mixture containing polypropylene and a particulate organic filler; (II) a first outer layer consisting essentially of a mixture containing polypropylene and an inorganic filler; and (III) a second outer layer consisting essentially of a mixture containing polypropylene and an inorganic filler; said co-extrusion being carried out in a manner to ensure an integral structure, i. e. provides for interfusion of the carrier layer with each of the first and second outer layers at mutually opposite interfaces between the carrier layer and the outer layers.

[0005] It is believed to be essential for a preferred embodiment of the present invention in view of abrasion resistance that at least one and preferably both outer layers essentially consist of, rather than contain, polypropylene and an inorganic filler which, in turn, is particulate and generally not fibrous. Preferably, average particle sizes of the inorganic filler are in the range of from about 1 to about 500 µm, preferably in the range of from about 5 to about 100 µm, and specific examples will be given below.

[0006] If the outer layers contain other components, e.g. stabilizers, dyes or pigment, such other components should, in general, not exceed an amount of 10 %, by weight, based upon the weight of the composition forming the outer layers. Inorganic pigment is, of course, regarded as "mineral filler". It is to be noted that maximum abrasion resistance is of essence for that outer layer which will be exposed to maximum abrasion. Now, in the preferred use of the stratiform material according to the invention, i.e. for manufacture of fruit or vegetable containers in the form of crates or boxes, such containers generally will have an "outer" and an "inner" surface, each of which is exposed to different types of wear. Typically, in the case of fruit or vegetable boxes, the abrasion wear of the "outer" surface (i.e. the one frequently exposed to contact with the ground or other external bodies) will be substantially greater than that of the "inner" surface, i.e. the one in contact with the content of the containers, viz. vegetables or fruits.

[0007] When considering the general performance and use-properties of crates or boxes for packaging of fruits or vegetables and similar goods, two criteria - in addition to the costs of materials and manufacturing methods - are of primary importance, namely minimum weight and maximum stability, the latter notably including abrasion wear resistance.

[0008] Now, while mineral fillers increase abrasion wear resistance of a polypropylene composition containing them, such fillers will also tend to increase the specific weight of the composition containing them. Contrariwise, organic fillers will decrease the specific weight of a polypropylene composition containing them but impart less abrasion resistance, if any, to such a composition.

[0009] Hence, another preferred composite material according to the invention, as well as a container made of such material, will have a first outer layer consisting essentially of polypropylene and particulate mineral filler finely dispersed therein for maximum abrasion wear resistance, a central layer containing polypropylene and a major amount, at least, of an organic particulate filler for minimum specific weight, and a second outer layer with a balance of sufficient high wear resistance and sufficiently low specific weight. Such second outer layer will be used at the inner surface of the container made of such an "asymmetric" composite material. "Asymmetric" structure in this context is intended to refer to a composite material according to the invention where one of the outer layers contains a higher proportion of mineral filler than the other..

[0010] Generally, the term "particulate" is used herein in the sense of a material consisting of essentially compact particle shapes that show no clear preference for a specific, i.e. longitudinal, dimension. With reference to

the organic filler used for the central layer to minimize the specific weight thereof, particulate wood in the form of wood flour, saw-dust and the like conventional forms of particulate wood with a typical average particle size in the range of from about 0.01 - 5 mm is preferred but other forms of particulate organic and preferably vegetabilic nature can be used depending upon availability, price and other ecological, commercial, and technological considerations.

[0011] If the polymer/filler material used for production of the central layer, and/or - optionally - for one of the outer layers of an asymmetric composite, is derived from recycled material, e.g. obtained from production scrap or by comminuting articles made of the inventive stratiform material by thermoforming or the like shaping or molding methods, such central layer will contain some mineral filler in addition to the particulate organic filler while one outer layer of an asymmetric composite will contain some organic filler.

[0012] The amount of mineral filler present in the central layer should, of course, be kept at a sufficiently low level to insure a sufficiently low specific weight of the composition of the central layer while the amount of organic filler in one outer layer of an asymmetric composite according to the invention should be sufficiently low to insure sufficient abrasion resistance.

[0013] The term "polypropylene" as used herein refers to all forms of polymerized propylene including it's various tacticities, e.g. isotactic, syntactic as well as synisotactic forms, and encompassing homopolymers as well as thermoplastic copolymers, graft-copolymers etc. that typically have a softening temperature of at least about 150 °C. Polypropylene materials of various commercial provenience and having such molecular weights, melt viscosities and other processing parameters as are known to be suitable for extrusion purposes can be used in the present invention.

[0014] According to a general preferred embodiment, the present invention provides for a composite stratiform material having at least three interfused layers each containing polypropylene and at least one filler, characterized in that said material comprises: (I) a carrier layer formed of a mixture containing polypropylene and a particulate organic filler; (II) a first outer layer interfused with said carrier layer at a first interface and consisting essentially of a mixture containing polypropylene and an inorganic filler; and (III) a second outer layer interfused with said carrier layer at a second interface located opposite said first interface and consisting essentially of a mixture containing polypropylene and an inorganic filler.

[0015] Preferably, the central or carrier layer has a thickness of at least twice the thickness of each of the first and the second outer layer. A typical outer layer has a thickness in the range of from about 0.2 to about 0.4 mm and a typical stratiform material according to the invention will consist of two outer layers of about 0.2 mm and one carrier layer of about 1.2 mm. While thickness is not an essential parameter according to the invention, it is a major commercial advantage that a stratiform material according to the invention with a typical thickness of about 1.5 mm provides for excellent mechanical strength, toughness, and high abrasion resistance. While a three-layered structure is generally preferred according to the invention, additional (if relatively thin) layers may be applied, and for some purposes even a two-layered composite according to the invention might be of use, i.e. where the carrier layer that contains particulate organic filler forms an outer layer of the composite even though this is less preferred. In a similar manner, one of the outer layers might be formed of a polymer composition that contains a polymer other than polypropylene but is fusible with the polypropylene of the central layer and contains no filler, or contains a different type of filler but, again, this is less preferred.

[0016] Preferably, the polymer/filler-composition forming the carrier layer has a specific weight of not more than about 1.1 and contains from about 60 to about 5 %, by weight, of polypropylene and from about 40 to about 95 %, by weight, of a particulate and essentially nonfibrous organic filler as explained above, based upon the weight of said mixture forming said central layer. The mixture may contain some mineral filler as well if the feed stock includes recycled material; however, when using recycled material it must be assured that the polymer constituents are capable of interfusion upon heating. Further, all compositions for the layers may contain the usual additives, notably stabilizers, in conventional amounts. It is to be noted that specific weights as mentioned herein refer to the composition in the final product, i.e. in an essentially compacted or thermally fused state.

[0017] The polymer/filler composition forming the outer layers may have a specific weight of generally in the range from about 1.1 to about 1.5, and may contain from about 60 to about 40 %, by weight, of polypropylene and from about 40 to about 60 %, by weight, of said inorganic filler; generally, recycled material is used, if at all, only for one of the outer layers. Typical mineral fillers are powdered mineral substances of natural or synthetic origin including such materials as dolomite ($CaCO_3$), alumina, silica, silicates, ground glass, ashes, mineral fines, etc. as well as mixtures of such mineral fillers. Dyes and/or pigments including carbon black, titanium dioxide, etc. as well as other conventional additives may be incorporated in conventional amounts.

[0018] Generally, a composite stratiform material according to the invention has a thickness in the range of from 1 to 10 mm, preferably 1.2 - 3, and notably 1.4 to 2.0 mm, and a breakage angle at normal ambient temperature of at least about 135 angular degrees (°) and typically of about 180°. The breakage angle can be determined by cutting a sample of 200 mm x 50 mm and bending it back manually upon itself. Breakage angles of less than 90° are less preferred because they indicate brittleness. The outer layers may have about the

same or different thicknesses. If the thicknesses of the outer layers are not approximately equal, the surface of the product made of the material according to the invention which is exposed to abrasion, e.g. the outer side of a fruit or vegetable crate, should be formed by the thicker outer layer since the mineral filler is believed to be responsible, at least in part, for improved abrasion resistance. It has been found that the breakage angle as defined above provides a simple yet effective method to optimize thickness parameters as well as filler content of a composite multilayer material according to the invention.

[0019] As briefly mentioned above, the invention - according to a further embodiment thereof - provides for a stackable container of the general type used as a box or crate for shipping fruits or vegetables; conventionally, such containers are made of wood and cannot be recycled, or recycled only with regard to their caloric content. Containers according to the invention may have any required shape that can be produced easily by pressing a thermally plasticized (preferably at a temperature in the range of from about 180°C - 280°C) stratiform material into a mould (preferably under a pressure in the range of from about 20 - 200 bar) so as to yield an integral or monolithic box-shaped container, i.e. having a bottom and side walls, optionally reinforced by ribs or the like, and a generally open upper side. The edges and/or corner areas may have an increased thickness to provide for sufficient stability for stacking at least 5 and preferably at least about 10 loaded containers on top of each other without breakage.

[0020] The present invention differs from the content of the above mentioned European patent application EP-A-0 668 142 in a number of aspects: first, with regard to objects, the present invention aims at a composite stratiform material that is particularly suited for production of containers with improved surface abrasion stability, such as are used for packaging and transporting fruits and vegetable products. A further object is to provide for a composite stratiform material having improved surface abrasion resistance while also having a relatively low specific weight and, last but not least, being capable of true recycling, i.e. repeated use of the material for producing identical or comparable articles of use without separation of polymer and filler constituents.

[0021] As regards essential features, it will be apparent from the above description that the present invention differs from EP-A-0 668 142 in that the organic filler in the present invention is not fibrous but particulate, i.e. does not have a prominent length dimension; in a particulate organic filler material suitable for use according to the invention, such as particulate wood in the form of saw dust or wood flour, the largest particle dimension in any direction of space is not more than about 5 times greater than the smallest dimension in any direction of space.

[0022] Further, in the present invention, the polymer-filler mixture used for the layer between the outer layers (termed carrier layer herein) is not treated in a counter-rotating extrusion press; rather, the materials for all layers of the composite stratiform material according to the invention can be, and preferably are, produced by the same type of co-rotating double-screw or twin-screw extruder and fed into a common nozzle having at least three different inlet openings and only one outlet opening for co-extrusion as a stratiform composite material. The term "stratiform" as used herein is intended to designate a structure having a relatively small thickness dimension of typically in the range of from about 1 mm to about 10 mm and a typical width dimension of at least about 50 times the thickness dimension while a typical "length" dimension could be virtually infinite in line with a continuous production process. Cutting the stratiform material to a specified length, such as typically in the range of from about 1000 to about 5000 mm, is a mere matter of convenience and can be omitted if the web emanating from the extruder (and a subsequent roller or calander means) is introduced directly into a shaping operation, e.g. by reheating the web and by producing shaped articles of any desired type by stamping or press-molding the web in a suitable press. The term "web" as used herein relates to the stratiform structure resulting from extrusion and calendaring and retaining some heat so as to conserve sufficient plasticity for easy processing without breakage.

[0023] The invention will be illustrated but not limited by means of the enclosed drawings in which:

Fig. 1 is a diagrammatic sectional view of a broken-away portion of a composite stratiform material according to the invention;

Fig. 2 is a flow diagram showing process streams when practicing the method according to the present invention; and

Fig. 3 is a diagrammatic sectional view of an extrusion head for producing a three-layered composite stratiform material according to the invention.

[0024] The diagrammatic sectional side view of a stratiform material 1 according to the invention shown in Fig. 1 is intended to illustrate a carrier layer 10 interfused at opposite interfaces 11,13 with a first outer layer 12 and a second outer layer 14. It will be understood that there need not be a sharply defined interface at the transition between carrier layer 10 and the adjacent outer layers 12,14 because some intermixing may occur during co-extrusion of the three layers according to the invention.

[0025] The outer surfaces 15 and 17 of the composite material 1 are the exposed surfaces of any product produced from such materials and provide improved resistance against abrasion due to their content of mineral filler. It is to be noted that most polypropylenes have a relatively high abrasion resistance as such; the use of pure polypropylene, however, is less economical than

the use of a mixture containing a filler that is available at low cost and with no substantial ecological problems. Since the material according to the invention is capable of being recycled for repeated use in typical articles made therefrom, such as fruit crates or boxes, the ecological advantages provided by the invention are substantial.

**[0026]** Fig. 2 illustrates a diagrammatic top view of an apparatus 2 for producing the composite material according to the invention. Apparatus 2 includes a first co-rotational twin-screw extruder 21 of the type known per se in the art of extrusion. In it's feeding region 211, polypropylene is introduced by a conventional feeding installation (not illustrated in Fig.2); further, particulate wood as explained above is fed via a lateral extruder 24 which, in turn, preferably is a co-rotational twin-screw extruder operated to remove excessive humidity from the particulate wood filler prior to it's introduction into extruder 21.

**[0027]** At least one further extruder 22 and/or 23 is used to feed a mixture of polypropylene and mineral filler for outer layers 12,14 into a co-extrusion nozzle or head 27 explained in more detail below. Extruders 22 and/or 23 are co-rotational twin-screw extruders. Obviously, the output capacities of extruders 22 and/or 23 will be selected, in a manner known to persons experienced in the art of extrusion, to the output capacity of extruder 21. For example, extruder 21 might have a screw diameter of 140 mm and a length of 32 times the diameter while extruder 22 and/or 23 might have a screw diameter of 70 mm, again with a length of 32 times the screw diameter; other operational parameters relating to the rate of output, such as speed of screw rotation, should be about the same while heating may be controlled differentially for optimal operation, depending upon the melt viscosity of the extruded composition.

**[0028]** Output ends 212, 222 and 232 feed into co-extrusion head 27 explained below. Head 27, on the other hand, produces an essentially endless web 28 of hot three-layer composite according to the invention. Generally, a calander 29 is used to smoothen the surfaces of web 28 and to consolidate the composite structure. Downstream of calander 29, web 28 will be shaped (in a manner not shown) into the desired type of article or cut into panels.

**[0029]** Fig. 3 is a semi-diagrammatic sectional illustration of a co-extrusion head 3 for use in the present invention. It is formed essentially of two matching die portions 31,32 joined by a bolt 321. Die portion 31 is provided with three feeding ends 33,34,35 for connection with extruders as shown in Fig. 2, it being understood that one extruder might serve to feed both ends 33,35 if the compositions of both outer layers are identical. Passages 330, 340 and 350 are provided in die portion 31 so as to feed a common conduit 36 for passing the three-layered composite formed by merging of the outlet conduits of passages 330,340 and 350. Slide valves 331, 341, 351 are provided for control of the corresponding passages by adjusting the turning position of the nut-ends 332, 342 and 352 of cooperating control rods. Heating means 371, 372 are provided in die portion 31 for temperature control in a manner known per se. The outlet end of conduit 36 is be provided, again in a manner known per se, with a linear slot in accordance with the width of the web to be produced.

**[0030]** Various modifications of the illustrated example will be apparent to persons skilled in the art and are intended to be included within the scope of the invention.

**[0031]** For example, when the composition of both outer layers (12, 14 in Fig.1) is the same, one common extruder (i.e. either 22 or 23 in Fig. 2) can be used for producing both outer layers; a forked connection between that extruder 22 or 23, and head 27, a manifold, or the like means of dividing a stream of a hot mixture of polypropylene and filler into two separate streams for producing the outer layers may be used to that end. Further, inclusion of small gas bubbles, or in other words, a finely "foamed" structure of the central layer may be used to further reduce the specific weight of composite materials according to the invention. By the same token, organic fillers having a finely porous structure may be used to reduce the specific weight of the central or carrier layer according to the invention.

## Claims

1. A method of producing a composite stratiform material by co-extrusion of at least three layers, each comprising polypropylene and at least one filler, said co-extrusion being effected by means of at least one extruder having a pair of co-rotating screws; said method comprising co-extruding a carrier layer (10) formed of a mixture containing polypropylene and a particulate organic filler; a first outer layer (12) consisting essentially of a mixture containing polypropylene and an inorganic filler; and a second outer layer (14) consisting essentially of a mixture containing polypropylene and an inorganic filler; said co-extrusion providing for interfusion of said carrier layer (10) with each of said first and said second outer layers (12,14) at mutually opposite interfaces (11,13) between said carrier layer (10) and said outer layers (12,14), wherein particulate wood or other forms of particulate organic and preferably vegetabilic nature is used as said particulate organic filler in said carrier layer (10) which is extruded by means of a co-rotational first extruder (21) for extruding said carrier layer (10) while said mineral filler is introduced into at least one second extruder (22,23) for extruding at least one of said outer layers (12,14).

2. The method of claim 1, wherein one of said outer layers (12,14) essentially consists of a mixture of

polypropylene and particulate inorganic filler.

3. The method of claims 1 or 2 wherein a mixture of polypropylene and filler obtained by comminution of articles made by thermal molding of said stratiform composite material, or of production scrap, is used for extruding said carrier layer (10).

4. The method of any of claims 1 - 3, wherein said particulate wood is fed into said first co-rotational extruder (21) by means of an additional co-rotational twin-screw extruder (24) laterally connected with said first extruder (21) near a feeding end region (211) of said first extruder (21).

5. The method of claim 1, wherein said carrier layer (10) has a thickness of at least twice the thickness of each of said first and said second outer layers (12,14).

6. The method of claim 1, wherein said mixture forming said carrier layer (10) has a specific weight of not more than about 1 and contains from about 60 to about 5 %, by weight, of polypropylene and from about 40 to about 95 %, by weight, of said organic filler, based upon the weight of said mixture forming said carrier layer (10) while said mixture forming said first and said second outer layers has a specific weight of at least about 1.1 and contains from about 60 to about 40 % by weight of polypropylene and from about 40 to about 60 % by weight of said inorganic filler.

7. The method of claim 1 characterized by co-extruding said stratiform material so as to have an overall thickness in the range of from 1 to 10 mm and a breakage angle at normal ambient temperature of at least about 135 angular degrees.

8. A stackable container suitable for use as a box or crate for shipping fruits, vegetables or similar goods; wherein said container consists essentially of a composite stratiform material having at least three interfused layers each containing polypropylene and at least one filler; wherein said material comprises:

a carrier layer (10) formed of a mixture containing polypropylene and particulate wood or other forms of particulate organic and preferably vegetabilic nature as said filler, said mixture having a specific weight of not more than about 1;
a first outer layer (12) interfused with said carrier layer (10) at a first interface and consisting essentially of a mixture containing polypropylene and an inorganic filler; and
a second outer layer (14) interfused with said carrier layer (10) at a second interface located opposite said first interface (12) and consisting essentially of a mixture containing polypropylene and an inorganic filler.

9. The container of claim 8 wherein one of said outer layers is an abrasion-exposed outer layer consisting essentially of said polypropylene and said mineral filler, wherein said carrier layer (10) has a thickness of at least twice the thickness of each of said first and said second outer layers (12,14); said mixture forming said carrier layer (10) containing from about 60 to about 5 %, by weight, of polypropylene and from about 40 to about 95 %, by weight, of said particulate wood, based upon the weight of said mixture forming said carrier layer (10) while said mixture forming said first and said second outer layers has a specific weight of at least about 1.1 and contains from about 60 to about 40 % by weight of polypropylene and from about 40 to about 60 % by weight of said inorganic filler.

10. The container of any of claim 9 or 9 characterized in that said layers (10,12,14) have a total thickness in the range of from 1 to 10 mm and a breakage angle at normal ambient temperature of at least about 135 angular degrees.

**Patentansprüche**

1. Verfahren zur Herstellung eines Verbundschichtmaterials durch gemeinsame Extrusion von mindestens drei Schichten, von denen jede Polypropylen und mindestens einen Füller enthält, wobei die gemeinsame Extrusion mittels mindestens eines Extruders bewirkt wird, der zwei gleichsinnig rotierende Schnecken umfasst, wobei das Verfahren das gemeinsame Extrudieren einer Trägerschicht (10) umfasst, die aus einer Mischung enthaltend Polypropylen und einen teilchenförmigen organischen Füller besteht, wobei eine erste Aussenschicht (12) im wesentlichen aus einer Mischung enthaltend Polypropylen und einen anorganischen Füller besteht und eine zweite Aussenschicht (14) im wesentlichen aus einer Mischung enthaltend Polypropylen und einen anorganischen Füller besteht, wobei die gemeinsame Extrusion zur Verschmelzung der Trägerschicht (10) mit jeder der ersten und zweiten Aussenschichten (12, 14) an einander entgegengesetzten Grenzflächen (11, 13) zwischen der Trägerschicht (10) und den Aussenschichten (12, 14) führt, wobei teilchenförmiges Holz oder ein teilchenförmiger organischer und vorzugsweise vegetabilischer Füller als teilchenförmiger organischer Füller in der Trägerschicht (10) verwendet wird, die mittels eines gleichsinnig rotierenden ersten Extruders (21) zum Extrudieren der Trägerschicht (10) extrudiert wird, wobei der mine-

ralische Füller in mindestens einen zweiten Extruder (22, 23) eingeführt wird, um mindestens eine der Aussenschichten (12, 14) zu extrudieren.

2. Verfahren nach Anspruch 1, bei dem eine der Aussenschichten (12, 14) im wesentlichen aus einer Mischung aus Polypropylen und teilchenförmigem, anorganischem Füller besteht.

3. Verfahren nach den Ansprüchen 1 oder 2, bei dem eine Mischung aus Polypropylen und Füller, die durch Zerkleinern von Gegenständen, die durch thermisches Verformen des Verbundschichtmaterials oder aus Produktionsabfall erhalten ist, zum Extrudieren der Trägerschicht (10) verwendet wird.

4. Verfahren nach einem der Ansprüche 1-3, bei dem teilchenförmiges Holz in den ersten gleichsinnig umlaufenden Extruder (21) mittels eines zusätzlichen gleichsinnig rotierenden Doppelschneckenextruders (24) eingespeist wird, der seitlich mit dem ersten Extruder (21) nahe eines Einspeisungsendbereichs (211) des ersten Extruders (21) verbunden ist.

5. Verfahren nach Anspruch 1, bei dem die Trägerschicht (10) eine Dicke von mindestens zweimal der Dicke jeder der ersten und zweiten Aussenschichten (12, 14) aufweist.

6. Verfahren nach Anspruch 1, bei dem die Mischung, welche die Trägerschicht bildet, ein spezifische Gewicht von nicht über etwa 1 besitzt und etwa 60 bis etwa 5 Gew.% Polypropylen und etwa 40 bis etwa 95 Gew.& des organischen Füllers enthält, bezogen auf das Gewicht der die Trägerschicht (10) bildenden Mischung, wobei die Mischung, welche die erste und zweite Aussenschicht bildet, ein spezifisches Gewicht von mindestens etwa 1,1 hat und etwa 60 bis etwa 40 Gew.% Polypropylen und etwa 40 bis etwa 60 Gew.% des anorganischen Füllers enthält.

7. Verfahren nach Anspruch 1, gekennzeichnet durch gemeinsames Extrudieren des schichtförmigen Materials, um diesem eine Gesamtdicke im Bereich von etwa 1 bis 10 mm und einen Bruchwinkel bei normaler Umgebungstemperatur von mindestens etwa 135 Winkelgraden zu verleihen.

8. StapelbarerBehälter, der zur Verwendung als Kiste oder Trage zum Transportieren von Früchten, Gemüsen oder ähnlichen Gütern geeignet ist, wobei der Behälter im wesentlichen aus einem Verbundschichtmaterial besteht, der mindestens drei miteinander verschmolzene Schichten aufweist, von denen jede Polypropylen und mindestens einen Füller enthält, wobei das Material umfasst:

eine Trägerschicht (10), die aus einer Mischung enthaltend Polypropylen und teilchenförmiges Holz oder einen teilchenförmigen organischen und vorzugsweise vegetabilischen Füller enthält, wobei die Mischung ein spezifisches Gewicht von nicht mehr als etwa 1 besitzt;

eine erste Aussenschicht (12), die mit der Trägerschicht (10) an einer ersten Grenzfläche verschmolzen ist und im wesentlichen aus einer Mischung enthaltend Polypropylen und einen anorganischen Füller besteht; und

eine zweite Aussenschicht (14), die mit der Trägerschicht (10) an einer zweiten Grenzschicht verschmolzen ist, die entgegengesetzt zur ersten Grenzfläche (12) liegt und im wesentlichen aus einer Mischung enthaltend Polypropylen und einen organischen Füller besteht.

9. Behälter nach Anspruch 8, bei dem eine der Aussenschichten eine dem Abrieb ausgesetzte Aussenschicht ist, die im wesentlichen aus dem Polypropylen und dem mineralischen Füller besteht, wobei die Trägerschicht (10) eine Dicke von mindestens zweimal der Dicke jeder der ersten und zweiten Aussenschichten (12, 14) besitzt, wobei die Mischung, welche die Trägerschicht (10) bildet, etwa 60 bis etwa 5 Gew.% Polypropylen und etwa 40 bis etwa 95 Gew.% teilchenförmiges Holz enthält, bezogen auf das Gewicht der die Trägerschicht (10) bildenden Mischung, während die Mischung, welche die erste und zweite Aussenschicht bildet, ein spezifisches Gewicht von mindestens etwa 1,1 besitzt und etwa 60 bis etwa 40 Gew.% Polypropylen und etwa 40 bis etwa 60 Gew.% des anorganischen Füllers enthält.

10. Behälter nach einem der Ansprüche 8 oder 9 (?), dadurch gekennzeichnet, dass die Schichten (10, 12, 14) eine Gesamtdicke im Bereich von 1 bis 10 mm und einen Bruchwinkel bei normaler Umgebungstemperatur von mindestens etwa 135 Winkelgraden besitzen.

**Revendications**

1. Procédé de production d'un matériau composite multicouches par co-extrusion d'au moins trois couches, chaque couche comprenant du polypropylène et au moins une charge, ladite co-extrusion étant réalisée par l'intermédiaire d'au moins une extrudeuse comportant une paire de vis de co-rotation; ledit procédé comprenant la co-extrusion d'une couche de support (10) composée d'un mélange contenant du polypropylène et une charge organique particulaire; d'une première couche externe (12) composée pour l'essentiel d'un mélange contenant du polypropylène et d'une

charge inorganique; et d'une deuxième couche externe (14), composée pour l'essentiel d'un mélange contenant du polypropylène et d'une charge inorganique; ladite co-extrusion assurant la réunion par fusion de ladite couche de support (10) et de chacune desdites première et deuxième couches externes (12, 14) au niveau d'interfaces mutuellement opposées (11, 13) entre ladite couche de support (10) et lesdites couches externes (12, 14), du bois particulaire ou d'autres formes de matériaux particulaires organiques et de préférence de nature végétale étant utilisés pour constituer ladite charge organique particulaire dans ladite couche de support (10), extrudée par l'intermédiaire d'une première extrudeuse de co-rotation (21), pour extruder ladite couche de support (10), ladite charge minérale étant introduite dans au moins une deuxième extrudeuse (22, 23) pour extruder au moins une desdites couches externes (12, 14).

2. Procédé selon la revendication 1, dans lequel une desdites couches externes (12, 14) est composée pour l'essentiel d'un mélange de polypropylène et d'une charge particulaire inorganique.

3. Procédé selon les revendications 1 ou 2, dans lequel un mélange de polypropylène et d'une charge produite par fragmentation d'articles produits par moulage thermique dudit matériau composite multicouches, ou des rebuts de la production, est utilisé pour extruder ladite couche de support (10).

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel ledit bois particulaire est amené dans ladite première extrudeuse à co-rotation (21) par l'intermédiaire d'une extrudeuse à deux vis à co-rotation additionnelle (24) connectée latéralement à ladite première extrudeuse (21) près d'une région d'extrémité d'alimentation (211) de ladite première extrudeuse (21).

5. Procédé selon la revendication 1, dans lequel ladite couche de support (10) a une épaisseur représentant au moins le double de l'épaisseur de chacune desdites première et deuxième couches externes (12, 14).

6. Procédé selon la revendication 1, dans lequel ledit mélange formant ladite couche de support (10) a un poids spécifique non supérieur à environ 1 et contient entre environ 60 et environ 5% en poids de polypropylène et entre environ 40 et environ 95% en poids de ladite charge organique, sur la base du poids dudit mélange formant ladite couche de support (10), ledit mélange formant lesdites première et deuxième couches externes ayant un poids spécifiques correspondant au moins à environ 1,1 et contenant entre environ 60 et environ 40% en poids de polypropylène et entre environ 40 et environ 60% en poids de ladite charge inorganique.

7. Procédé selon la revendication 1, caractérisé par une co-extrusion dudit matériau multicouches, de sorte à atteindre une épaisseur globale comprise dans l'intervalle allant de 1 à 10 mm et un angle de rupture en présence d'une température ambiante normale d'au moins 135 degrés angulaires.

8. Récipient empilable pouvant être utilisé comme une boîte ou une caisse pour l'expédition de fruits, de légumes ou d'autres denrées similaires; ledit récipient étant composé pour l'essentiel d'un matériau composite multicouches comportant au moins trois couches réunies par fusion, contenant chacune du polypropylène et au moins une charge; ledit matériau comprenant:

   une couche de support (10) composée d'un mélange contenant du polypropylène et du bois particulaire ou d'autres formes de matériaux particulaires organiques et de préférence de nature végétale constituant ladite charge, ledit mélange ayant un poids spécifique non supérieur à environ 1;
   une première couche externe (12) réunie par fusion avec ladite couche de support (10) au niveau d'une première interface et composée pour l'essentiel d'un mélange contenant du polypropylène et d'une charge inorganique; et
   une deuxième couche externe (14) réunie par fusion avec ladite couche de support (10) au niveau d'une deuxième interface opposée à ladite première interface (12) et composée pour l'essentiel d'un mélange contenant du polypropylène et d'une charge inorganique.

9. Récipient selon la revendication 8, dans lequel une desdites couches externes est une couche externe exposée à l'abrasion, composée pour l'essentiel dudit polypropylène et de ladite charge minérale, ladite couche de support (10) ayant une épaisseur représentant au moins le double de l'épaisseur de chacune desdites première et deuxième couches externes (12, 14) ; ledit mélange formant ladite couche de support (10) contenant entre environ 60 et environ 5% en poids de polypropylène et entre environ 40 et environ 95% en poids dudit bois particulaire, sur la base du poids dudit mélange formant ladite couche de support (10), ledit mélange formant lesdites première et deuxième couches externes ayant un poids spécifique correspondant au moins à environ 1,1 et contenant entre environ 60 et environ 40% en poids de polypropylène et entre environ 40 et environ 60% en poids de ladite

charge inorganique.

10. Récipient selon l'une quelconque des revendications 8 ou 9, caractérisé en ce que lesdites couches (10, 12, 14) ont une épaisseur totale comprise dans l'intervalle compris entre 1 à 10 mm et un angle de rupture en présence d'une température ambiante normale correspondant au moins à environ 135 degrés angulaires.

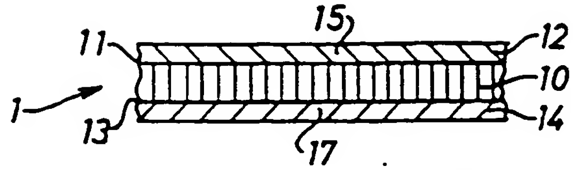


Fig. 1

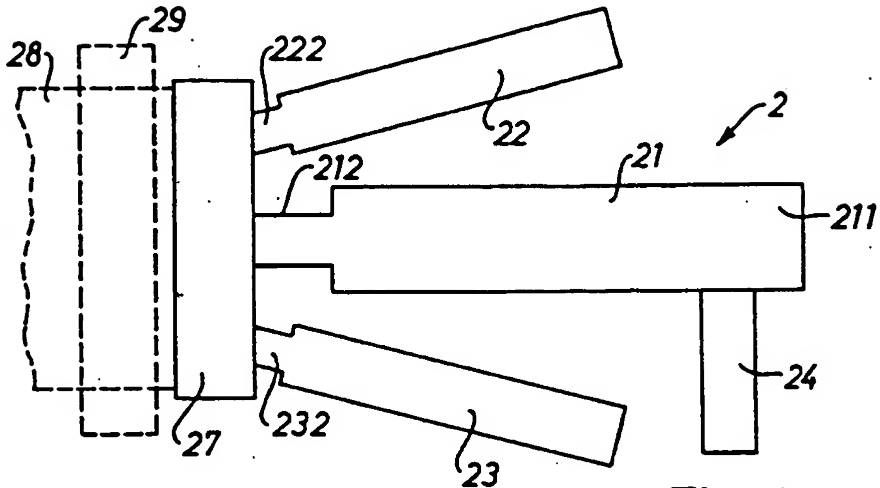


Fig. 2

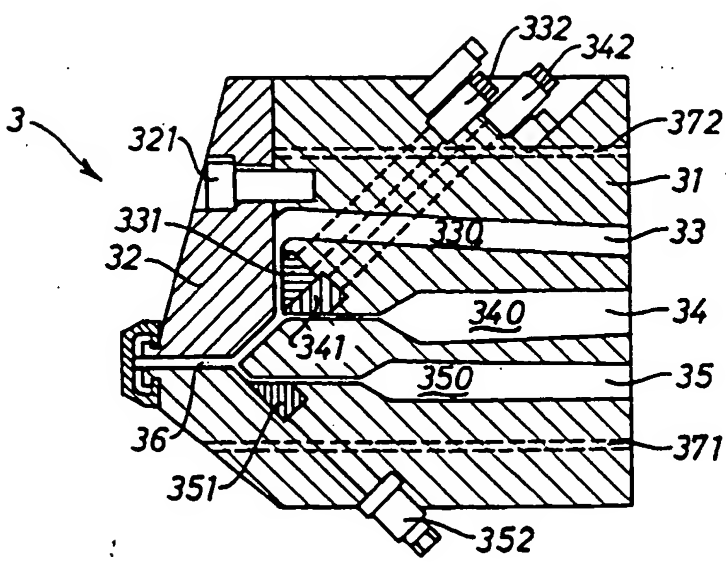


Fig. 3